CLAIMS

1. A photosensitive material characterized by at least one organic species in an organic-inorganic matrix, the organic at least one species comprising a material having a refractive index which changes upon exposure to actinic radiation.

2. A photosensitive material according to claim 1, characterized in that the organic species comprises one or more of efficient organic photosensitive and photoinitiating species together with a monomer or a mixture of monomers.

3. A photosensitive material according to claim 1 or 2, characterized in that organic-inorganic matrix comprises an organically modified glassy host with the organic species dispersed therein and/or chemically-bonded thereto.

4. A photosensitive material according to claim 3, characterized in that the organic species is bonded to the organic-inorganic matrix by covalent bonding.

5. A photosensitive material according to claim 3, characterized in that the organic species comprises a dispersion in the organic-inorganic material.

6. A photosensitive material according to claim 1, characterized in that the at least one organic species is entrapped as a guest within the organic-inorganic host matrix.

7. A photosensitive material according to any one of claims 1 to 6, characterized in that the photosensitive material comprises a product of a sol-gel process.

8. A photosensitive material according to any of claims 1 to 7, characterized in that the organic species is selected from the group comprising halogen-substituted acetophenones, chromophore-substituted triazines, azo dies, benzoin ethers, ketals, o-acylated oximino ketones, acyl phosphine oxides, aromatic ketones, hexaarylbisimidazoles, bis(p-dialkylaminobenzilidene)ketones, thioxanthones,

ketocoumarins, 9-phenylacridine, die-sensitized systems such as xantene, acridinium, phenazine and thiazine dyes in combination with activators such as amines, sulfinates, enolates, carboxylates and organotine compounds, dye-borate complexes, ferrocenium salts, aluminate complexes, protic acid generators such as sulfonium or iodonium salts capable of initiating cationic polymerization, and organometallic systems such as dicyclopentadienyltitanocenes, in particular bis(pentafluorophenyl)titanocene, titanocene/N-phenylglycine, and bis(μ^5-2,4-cyclopentadien-1-yl)-bis- [2,6-difluoro-3-(1H-pyrrol-1-yl)phenyl]titanium; and bis(p-dialkylaminobenzilidene) ketones in combination with a hexaarylbisimidazole initiating system with charge transfer agents such as 2-mercaptobenzoxazole.

9. A photosensitive material according to any of claims 1 to 7, characterized in that the organic species is selected from the monomers capable of free radical or cationic polymerization, respectively.

10. A photosensitive material according to claim 9, characterized in that the monomers are ethylenically unsaturated monomers capable of free radical addition polymerization.

11. A photosensitive material according to claim 10, characterized in that the monomers are acrylate or methacrylate monomers with high propagation and low termination rates.

12. A photosensitive material according to claim 10, characterized in that the monomers are either liquid monomers, or solid monomers or a combination of one or more solid monomers and one or more liquid monomers.

13. A photosensitive material according to claim 10, 11 or 12, characterized in that the monomers are selected from the group comprising phenyl acrylate, 2-phenoxyethyl acrylate, N-vinylcarbazol, 3,6-dibromo-9-vinyl carbazol, p-chlorophenyl acrylate, hexanediol diacrylate, vinyl benzoate, tert-butyl hydroperoxide, hexanediol diacrylate, 2,4,6-tribromophenyl acrylate, phenyl acrylate, orthobiphenyl acrylate, orthobiphenyl

methacrylate, di(2-acryloxyethyl) ether of bisphenol-A, 2-phenylethyl acrylate, di-(p-clorophenoxy)ethyl acrylate, and pentachlorophenyl acrylate.

14. A photosensitive material according to claim 10, characterized in that the monomers are selected from the group comprising multifunctional monomers containing two or more ethylenically unsaturated groups.

15. A photosensitive material according to claim 14, characterized in that the monomers are selected from the group consisting of ethylene glycol diacrylate, diethylen glycol diacrylate, 1,4-butanediol diacrylate, decamethylene glycon diacrylate, 1,4-cyclohexanediol diacrylate, glycerol diacrylate, glycerol triacrylate, ethylene glycol dimethacrylate, butylene glycol dimethacylate, tripropylene glycol diacrylate, di(2-acryloxyethyl) ether of bisphenol-A, di(2-acryloxyethyl) ether of tetrabromo-bisphenol-A.

16. A photosensitive material according to claim 10 or 12, characterized in that the monomers are those capable of cationic ring opening polymerization (CROP).

17. A photosensitive material according to claim 16, characterized in that the monomers have two or more cyclohexene oxide groups linked through siloxane chain segments, for example 1,3-bis[2-(3{7-oxabicyclo[4.1.0]heptyl})ethyl]-tetramethyl disiloxane.

18. A material according to any one of claims 1 to 17, characterized in that the organic-inorganic matrix comprises a material synthesized using organo alkoxysilanes as one or more of the precursors for a sol-gel reaction in which organic groups are introduced within an inorganic network through the Si-C- bond.

19. A material according to any one of claims 1 to 17, characterized in that the matrix material comprises, in the presence of dispersed photosensitive, photoinitiating and photopolymerizable species, copolymerized epoxysilanes and either or both of a tetraalkoxysilane and a trialkoxysilane.

20. A material according to claim 19, characterized in that the epoxysilane is a (3-glycidoxypropyl) trialkoxysilane.

21. A material according to any one of claims 1 to 17, characterized in that the organic-inorganic matrix comprises functionalized oligomers or polymers co-condensated with metal alkoxides in which chemical bonding is between inorganic and organic parts.

22. A material according to any one of claims 1 to 17, characterized in that the organic-inorganic matrix material comprises an inorganic species within a polymer matrix.

23. A material according to any one of claims 1 to 17, characterized in that the organic-inorganic matrix comprises an inorganic species, generally in the form of particles with a characteristic size of a few hundred angstroms, generated in situ within a polymer.

24. A material according to any one of claims 1 to 17, characterized in that the organic-inorganic matrix material comprises either previously formed oxide gels infiltrated by polymerizable organic monomers or polymers mixed with metal alkoxides in a common solvent.

25. A material according to any one of claims 1 to 17, characterized in that the organic-inorganic matrix material comprises porous oxide gels impregnated with organics and polymerized *in situ* using thermal or irradiation processes.

26. A material according to any one of claims 1 to 17, characterized in that the material comprises an oxide network formed by condensation of metal alkoxide in the presence of polymers.

27. A material according to any one of claims 1 to 17, characterized in that the organic-inorganic matrix comprises a material formed by impregnating or entrapping organic material as a guest within the inorganic host matrix.

28 A material according to any one of claims 1 to 17, characterized in that the organic-inorganic matrix comprises a material formed by interpenetrating networks and simultaneous formation of inorganic and organic phases.

29. A material according to any one of claims 1 to 17, characterized in that the organic-inorganic matrix comprises a material formed as an organic network within an inorganic network by either photochemical or thermal curing thereof using triethoxysliane $R'Si(OR)_3$ or diethoxysilanes $R'R''Si(OR)_2$ as the precursor with R' and R" being a polymerizable group such as an epoxy group,

30. A material according to any one of claims 1 to 17, characterized in that the organic-inorganic matrix comprises a material formed as inorganic/organic simultaneous interpenetrating networks, where both inorganic glass and polymer formation occur concurrently.

31. A material according to claim 30, characterized in that the organic-inorganic matrix comprises a material synthesized through a synchronous application of the aqueous ring-opening metathesis polymerization of cyclic alkenyl monomers and the hydrolysis and condensation of metal alkoxides.

32. A process of making a photosensitive material characterized by the steps of forming an organic-inorganic matrix containing at least one organic species having a refractive index that changes on exposure to actinic radiation.

33. A process according to claim 32, characterized in that the process comprises a sol-gel process.

34. A process according to claim 32, characterized in that the organic-inorganic matrix is synthesized using organo alkoxysilanes as one or more of the precursors for a sol-gel reaction in which organic groups are introduced within an inorganic network through the Si-C- bond.

35. A process according to claim 32 or 33, characterized in that the matrix material is formed by copolymerization of epoxysilanes and either or both of a tetraalkoxysilane and a trialkoxysilane in the presence of dispersed photosensitive, photoinitiating and photopolymerizable species.

36. A process according to claim 35, characterized in that the epoxysilane used is a (3-glycidoxypropyl) trialkoxysilane.

37. A process according to claim 32 or 33, characterized in that the organic-inorganic matrix is formed by means of a co-condensation of functionalized oligomers or polymers with metal alkoxides in which chemical bonding is established between inorganic and organic phases.

38. A process according to claim 32, characterized in that the organic-inorganic matrix material is synthesized through the formation of inorganic species within a polymer matrix.

39. A process according to claim 32 or 33, characterized in that inorganic species, generally in the form of particles with a characteristic size of a few hundred angstroms, are generated in situ within polymers by first swelling cross-linked, ionomeric, or crystalline polymeric host with a compatible solution containing metal alkoxides followed by the promotion of the sol-gel reaction of the inorganics.

40. A process according to claim 32 or 33, characterized in that the organic-inorganic matrix material is obtained by either the infiltration of previously formed oxide gels with polymerizable organic monomers or the mixing of polymers with metal alkoxides in a

cómmon solvent.

41 A process according to claim 32, characterized in that the organic-inorganic matrix material is formed by impregnation of porous oxide gels with organics followed by an *in situ* polymerization initiated by thermal or irradiation processes.

42. A process according to claim 32 or 33, characterized in that the hydrolysis and condensation of metal alkoxide are carried out in the presence of polymers and organic-inorganic matrix material is formed by trapping polymers within the oxide gel network.

43. A process according to claim 32 or 33, characterized in that the organic-inorganic matrix material is formed by interpenetrating networks and simultaneous formation of inorganic and organic phases.

44. A process according to claim 32 or 33, characterized in that the organic-inorganic matrix material is formed as an organic network within the inorganic network by either photochemical or thermal curing of such groups. using triethoxysliane $R'Si(OR)_3$ or diethoxysilanes $R'R''Si(OR)_2$ as the precursor with R' and R" being a polymerizable group such as an epoxy group.

45. A process according to claim 32 or 33, characterized in that the organic-inorganic matrix material is formed as inorganic-organic simultaneous interpenetrating networks, where both inorganic glass and polymer formation occur concurrently.

46. A process according to claim 32 or 33, characterized in that said material is synthesized through a synchronous application of the aqueous ring-opening metathesis polymerization of cyclic alkenyl monomers and the hydrolysis and condensation of metal alkoxides.

47. A process according to claim 32 or 33, characterized by employing polymerizable

monomers as the cosolvents such that all the components contribute either to the inorganic network or to the organic polymer.

48. A body of photosensitive material characterized by at least one organic species in an organic-inorganic matrix, the organic at least one species comprising a material having a refractive index which changes upon exposure to actinic radiation, and other organic species comprise one or more efficient organic photosensitive and photoinitiating species together with a monomer or a mixture of monomers, the body having at least one volume hologram formed therein..